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C. W. McConaughy Reservoir Keith County, Nebraska

Pacific Northwest Environmental Research Lab, Corvallis, Oreg

Prepared for

Nebraska State Dept of Environmental Control, Lincoln

Aug 76

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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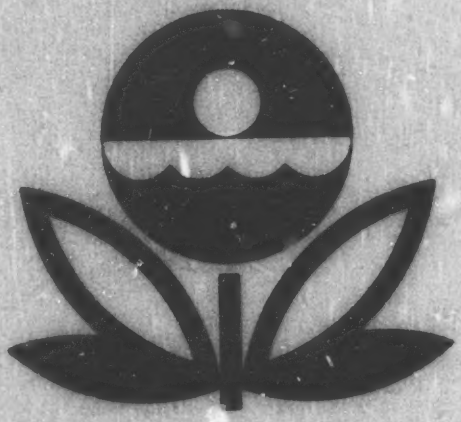

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REPORT
ON
C. W. McCONAUGHY RESERVOIR
KEITH COUNTY
NEBRASKA
EPA REGION VII
WORKING PAPER No. 559

WITH THE COOPERATION OF THE
NEBRASKA DEPARTMENT OF ENVIRONMENTAL CONTROL
AND THE
NEBRASKA NATIONAL GUARD

AUGUST, 1976

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Nebraska Department of Environmental Control for professional involvement, to the Nebraska National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

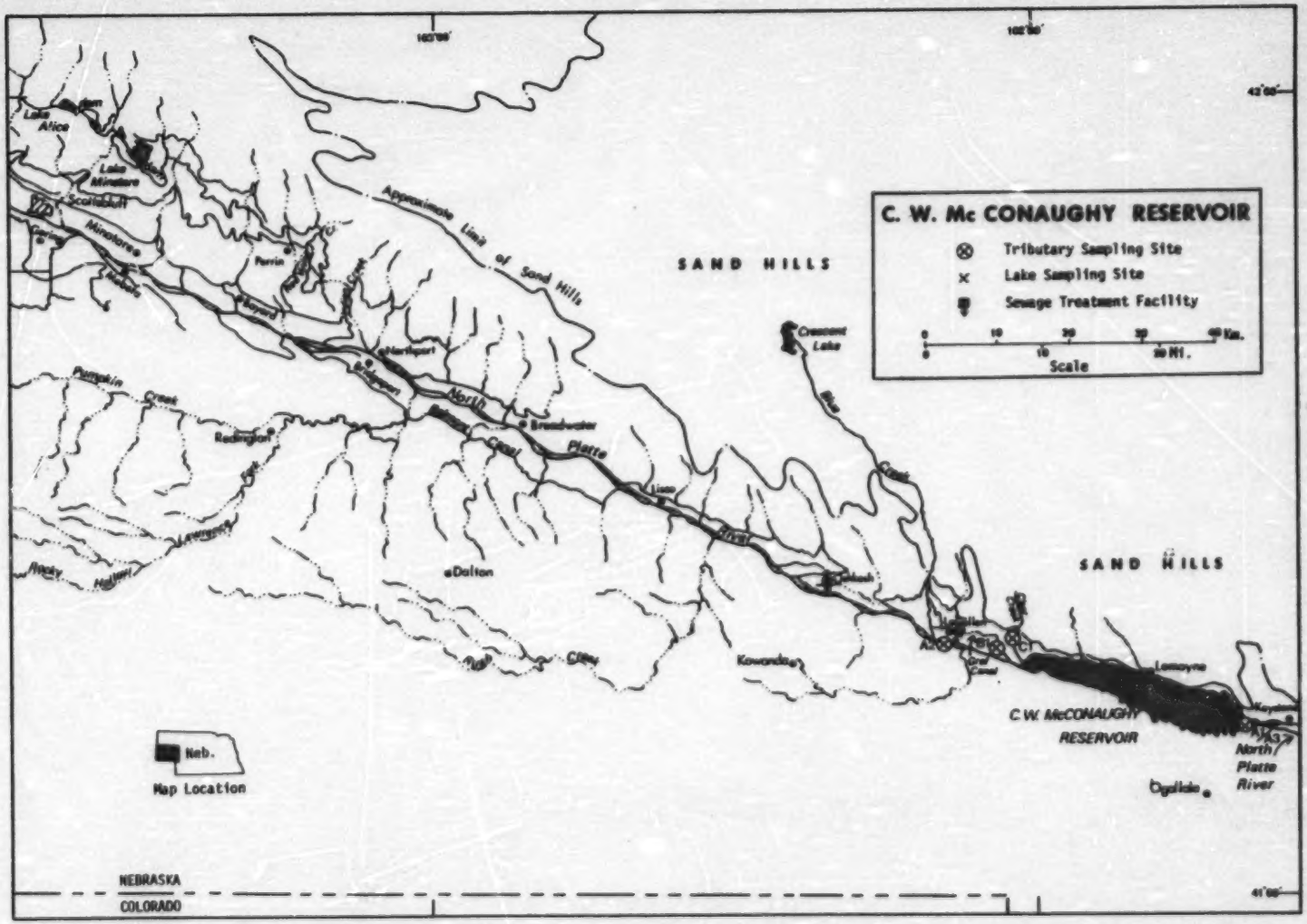
The staff of the Water Pollution Control Division, Department of Environmental Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Francis L. Winner, the Adjutant General of Nebraska, and Project Officer Colonel Burl M. Johnson, who directed the volunteer efforts of the Nebraska National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STATE OF NEBRASKA

RESERVOIR NAME	COUNTY
Branched Oak	Lancaster
Harlan County	Harlan
Harry D. Strunk	Frontier
Hugh Butler	Frontier, Red Willow
Johnson	Dawson, Gosper
McConaughy	Keith
Pawnee	Lancaster
Sherman	Sherman
Swanson	Hitchcock


C. W. Mc CONAUGHY RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
SAND HILLS
SAND HILLS
Approximate Limit of Sand Hills
Crescent Lake
North Platte River
Brandon
Dalton
Kovanda
Lemoyne
C.W. McCONAUGHY RESERVOIR
North Platte River
Ogallala
Nebr.
Map Location
NEBRASKA
COLORADO

C. W. McCONAUGHY RESERVOIR

STORET NO. 3106

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that McConaughy Reservoir is meso-eutrophic. It ranked first in overall trophic quality when the nine Nebraska reservoirs sampled in 1974 were compared using a combination of six lake parameters*. None of the other reservoirs had less median total phosphorus or median dissolved orthophosphorus, eight had less median inorganic nitrogen, one had less mean chlorophyll a, and none had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth (to 39% of saturation) occurred at sampling station 1 in July.

Survey limnologists did not observe any macrophytes or surface concentrations of algae during sampling visits.

B. Rate-Limiting Nutrient:

The algal assay results indicate that McConaughy Reservoir was phosphorus limited at the time the samples were collected (04/16/74 and 09/27/74). The reservoir data also indicate phosphorus limitation on those dates.

C. Nutrient Controllability:

1. Point sources--It is estimated that known point sources within 40 km of McConaughy Reservoir contributed less than 1%

* See Appendix A.

of the total phosphorus load to the reservoir during the sampling year. The major contributor was the Oshkosh wastewater treatment plant (0.6%).

The present phosphorus loading of 1.36 $g/m^2/yr$ is more than twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11), and it is unlikely that control of phosphorus at the nearby point sources would result in any appreciable improvement in the trophic condition of the reservoir. However, several wastewater treatment plants discharge to the North Platte River over 40 km upstream, and phosphorus removal at those facilities, in addition to those considered in this report, probably would result in some improvement in the trophic condition of the reservoir.

2. Non-point sources--Non-point sources (including point sources over 40 km upstream) are estimated to have contributed over 99% of the total phosphorus loading during the sampling year. The North Platte River contributed 90.0%, Clear Creek contributed 0.5%, and ungaged tributaries contributed an estimated 7.5%.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 141.64 kilometers^2.
2. Mean depth: 19.8 meters.
3. Maximum depth: 43.3 meters.
4. Volume: 2804.472 x 10^6 m^3.
5. Mean hydraulic retention time: 2.4 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
North Platte River	65,785.9	40.17
Clear Creek	51.8	0.22
Minor tributaries & immediate drainage -	842.6	4.69
Totals	66,680.3	45.08

2. Outlet -

North Platte River	66,821.9**	37.26

C. Precipitation***:

1. Year of sampling: 47.1 centimeters.
2. Mean annual: 45.8 centimeters.

† Table of metric conversions--Appendix B.
†† Hartung, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

McConaughy Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 33.5 meters at station 1, 20.7 meters at station 2, and 6.7 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not properly preserved and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE MCCONAUGHY
STORET CODE 3106

PARAMETER	1ST SAMPLING (4/16/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 1/74) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/27/74) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	5.4 - 6.4	5.9	5.9	12.9 - 22.9	18.6	20.3	16.0 - 17.8	17.2	17.2
DISS OXY (MG/L)	7.6 - 11.4	10.7	11.0	3.6 - 8.2	6.5	6.8	7.2 - 7.8	7.6	7.6
CNDCTVY (MCROMO)	491. - 510.	499.	497.	622. - 750.	697.	721.	658. - 667.	663.	665.
PH (STAND UNITS)	8.4 - 8.5	8.4	8.4	8.0 - 8.5	8.3	8.2	7.8 - 7.9	7.8	7.8
TOT ALK (MG/L)	199. - 216.	204.	203.	****** -**********			183. - 232.	194.	187.
TOT P (MG/L)	0.018 - 0.040	0.026	0.026	****** -**********			0.024 - 0.104	0.044	0.036
ORTHO P (MG/L)	0.002 - 0.007	0.003	0.003	****** -**********			0.003 - 0.008	0.005	0.005
NO2+NO3 (MG/L)	0.540 - 0.670	0.600	0.600	****** -**********			0.300 - 0.600	0.354	0.310
AMMONIA (MG/L)	0.020 - 0.050	0.034	0.035	****** -**********			0.040 - 0.160	0.067	0.060
KJEL N (MG/L)	0.200 - 0.680	0.271	0.200	****** -**********			0.400 - 1.200	0.625	0.550
INORG N (MG/L)	0.570 - 0.720	0.634	0.630	****** -**********			0.340 - 0.750	0.422	0.360
TOTAL N (MG/L)	0.750 - 1.140	0.871	0.830	****** -**********			0.700 - 1.510	0.979	0.860
CHLRPYL A (UG/L)	12.0 - 13.3	12.5	12.3	0.5 - 3.1	1.8	1.7	10.1 - 12.4	11.6	12.4
SECCHI (METERS)	0.9 - 1.8	1.3	1.0	0.6 - 7.6	4.4	5.0	0.4 - 2.1	1.2	1.2

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/16/74	1. Asterionella sp.	5,173
	2. Flagellates	4,362
	3. Cryptomonas sp.	734
	4. Stephanodiscus sp.	463
	5. Dactylococcopsis sp.	386
	Other genera	1,120
	Total	12,238
07/01/74	1. Cryptomonas sp.	860
	2. Fragilaria sp.	602
	3. Asterionella sp.	473
	4. Flagellates	344
	5. Schroederia sp.	344
	Other genera	690
	Total	3,313
09/27/74	1. Cryptomonas sp.	1,023
	2. Flagellates	884
	3. Dactylococcopsis sp.	651
	4. Melosira sp.	512
	5. Merismopedia sp.	419
	Other genera	1,442
	Total	4,931

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/16/74	1	12.3
	2	12.0
	3	13.3
07/01/74	1	0.5
	2	1.7
	3	3.1
09/27/74	1	12.4
	2	10.1
	3	12.4

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	<0.005	0.600	0.1
0.050 P	<0.055	0.600	12.5
0.050 P + 1.0 N	<0.055	1.600	13.7
1.0 N	<0.005	1.600	0.1

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.455	0.8
0.050 P	0.065	0.455	4.8
0.050 P + 1.0 N	0.065	1.455	10.0
1.0 N	0.015	1.455	0.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of McConaughy Reservoir was low in the spring (04/16/74) and moderate in the fall (09/27/74). Also, significant increases in yield with the addition of phosphorus alone indicate that the reservoir was limited by phosphorus on both occasions. Note that the addition of nitrogen alone resulted in yields no greater than those of the controls.

The reservoir data indicate phosphorus limitation in April and September (the mean inorganic nitrogen to orthophosphorus ratios were 63 to 1 or greater at all stations).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Nebraska National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v) except for site A-3. This site, the surface water outlet in Kingsley Dam, was not in use on any sampling occasion, so no samples were collected. Sampling was begun in August, 1974, and was completed in May, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nebraska District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station C-1, in kg/km^2/year, and multiplying by the ZZ area in km^2.

The operator of the Lewellen wastewater treatment plant provided monthly effluent samples and corresponding flow data. The operator of the Oshkosh wastewater treatment plant provided monthly effluent samples without flow estimates; nutrient loads from this source were estimated at 1.134 kg P and 3.401 kg N/capita/year, and flows were estimated at 0.3785 m^3/capita/day. The results of the analyses of the Oshkosh samples are included in Appendix E.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Lewellen	376	act. sludge	333.5	North Platte River
Oshkosh	1,067	act. sludge	403.9	North Platte River

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
North Platte River	173,210	90.0
Clear Creek	875	0.5
b. Minor tributaries & immediate drainage (non-point load) -	14,325	7.5
c. Known municipal STP's -		
Lewellen	265	0.1
Oshkosh	1,210	0.6
d. Septic tanks** -	45	<0.1
e. Known industrial - None	-	-
f. Direct precipitation*** -	2,480	1.3
Total	192,410	100.0

2. Outputs -

Lake outlet - North Platte River 38,575

3. Net annual P accumulation - 153,835 kg.

* Treatment plant questionnaires.
** Estimate based on 113 shoreline dwellings, five campgrounds, and two parks; see Working Paper No. 175.
*** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
North Platte River	3,836,835	90.9
Clear Creek	13,260	0.3
b. Minor tributaries & immediate drainage (non-point load) -	215,705	5.1
c. Known municipal STP's -		
Lewellen	800	<0.1
Oshkosh	3,630	0.1
d. Septic tanks* -	1,625	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	152,915	3.6
Total	4,224,770	100.0

2. Outputs -

Lake outlet - North Platte River 1,216,105

3. Net annual N accumulation - 3,008,665 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
North Platte River	3	58
Clear Creek	17	256

E. Mean Nutrient Concentrations in Ungaged Stream:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Graf Canal	0.123	1.469

* Estimate based on 113 shoreline dwellings, five campgrounds, and two parks; see Working Paper No. 175.
** See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	1.36	1.09	29.8	21.2

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of McConaughy Reservoir:

"Dangerous" (eutrophic loading)	0.56
"Permissible" (oligotrophic loading)	0.28

V. LITERATURE REVIEWED

Hartung, Ray, 1974. Personal communication (reservoir morphometry). NE Dept. of Env. Contr. Lincoln.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3101	BRANCHED OAK	0.044	0.070	456.444	17.033	9.400	0.013
3102	HARLAN COUNTY RESERVOIR	0.112	0.365	476.111	27.822	12.200	0.061
3103	HARRY D. STRUNK (MEDICIN	0.064	0.460	470.500	14.367	14.200	0.009
3104	HUGH BUTLER (RED WILLOW)	0.061	0.090	468.875	16.612	14.400	0.014
3105	JOHNSON RESERVOIR	0.075	0.340	477.667	26.133	8.600	0.009
3106	LAKE MCCONAUGHY	0.027	0.585	409.555	8.644	11.400	0.004
3107	PAWNEE LAKE	0.060	0.175	453.000	15.367	8.800	0.020
3108	SHERMAN COUNTY RESERVOIR	0.067	0.090	451.167	6.717	11.800	0.050
3110	SWANSON RESERVOIR	0.067	0.090	466.333	14.450	11.000	0.016

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3101	BRANCHED OAK	88 (7)	100 (8)	63 (5)	25 (2)	75 (6)	63 (5)	414
3102	HARLAN COUNTY RESERVOIR	0 (0)	25 (2)	13 (1)	0 (0)	25 (2)	0 (0)	63
3103	HARRY D. STRUNK (MEDICIN	50 (4)	13 (1)	25 (2)	75 (6)	13 (1)	81 (6)	257
3104	HUGH BUTLER (RED WILLOW)	63 (5)	75 (5)	38 (3)	38 (3)	0 (0)	50 (4)	264
3105	JOHNSON RESERVOIR	13 (1)	38 (3)	0 (0)	13 (1)	100 (8)	81 (6)	245
3106	LAKE MCCONAUGHY	100 (8)	0 (0)	100 (8)	88 (7)	50 (4)	100 (8)	438
3107	PAWNEE LAKE	75 (6)	50 (4)	75 (6)	50 (4)	88 (7)	25 (2)	363
3108	SHERMAN COUNTY RESERVOIR	38 (3)	75 (5)	88 (7)	100 (8)	38 (3)	13 (1)	352
3110	SWANSON RESERVOIR	25 (2)	75 (5)	50 (4)	63 (5)	63 (5)	38 (3)	314

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3106	LAKE MCCONAUGHY	438
2	3101	BRANCHED OAK	414
3	3107	PAWNEE LAKE	363
4	3108	SHERMAN COUNTY RESERVOIR	352
5	3110	SWANSON RESERVOIR	314
6	3104	HUGH BUTLER (RED WILLOW)	264
7	3103	HARRY D. STRUNK (MEDICIN	257
8	3105	JOHNSON RESERVOIR	245
9	3102	HARLAN COUNTY RESERVOIR	63

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3106 LAKE MCCONAUGHY

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 66821.9

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3106A1	66821.9	20.56	19.91	19.89	19.26	36.81	48.14	75.89	75.89	49.84	29.17	26.28	24.47	37.26
3106A2	65785.9	36.53	40.21	41.91	40.78	46.44	56.87	27.84	28.39	35.68	49.55	47.81	48.21	40.17
3106C1	51.8	0.24	0.25	0.26	0.23	0.22	0.20	0.16	0.16	0.22	0.22	0.25	0.24	0.22
3106ZZ	984.2	6.48	6.74	6.94	6.20	4.45	3.51	1.98	1.61	2.21	3.71	6.17	6.46	4.69

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 66821.9
SUM OF SUB-DRAINAGE AREAS = 66821.9

TOTAL FLOW IN = 541.71
TOTAL FLOW OUT = 445.28

NOTE *** TOTAL & ZZ DR. AREAS DIRECTLY CONTRIBUTING. 33300 SQ. MI. TOTAL AREA.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CKS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3106A1	8	74	77.42	24	75.89				
	9	74	52.56	15	52.95				
	10	74	15.57	6	22.37				
	11	74	12.23	24	13.42				
	12	74	30.55	8	31.15				
	1	75	19.77	19	14.38				
	2	75	13.76	8	15.86				
	3	75	11.92	16	11.30				
	4	75	18.66	13	10.70				
	5	75	29.19	18	39.36				
	6	75	34.01						
	7	75	104.97						
3106A2	8	74	24.58	24	22.69				
	9	74	48.88	15	52.39				
	10	74	56.49	6	59.47				
	11	74	44.71	24	43.64				
	12	74	42.39	8	45.87				
	1	75	43.87	19	50.97				
	2	75	39.96	8	33.98				
	3	75	34.55	16	34.83				
	4	75	44.74	13	43.61				
	5	75	37.69	18	39.36				
	6	75	36.98						
	7	75	27.58						

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TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3106 LAKE MCCONAUGHY

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3106C1	8	74	0.12	24	0.10				
	9	74	0.16	15	0.15				
	10	74	0.22	6	0.23				
	11	74	0.29	24	0.27				
	12	74	0.30	8	0.28				
	1	75	0.30	19	0.34				
	2	75	0.28	8	0.34				
	3	75	0.28	16	0.30				
	4	75	0.31	13	0.21				
	5	75	0.27	18	0.28				
	6	75	0.20						
	7	75	0.11						
3106ZZ	8	74	0.54	24	1.27				
	9	74	1.81	15	1.76				
	10	74	3.94	6	2.35				
	11	74	6.06	24	6.14				
	12	74	6.40	8	6.26				
	1	75	6.54	19	7.62				
	2	75	6.26	8	5.66				
	3	75	6.26	16	6.88				
	4	75	7.08	13	6.74				
	5	75	5.69	18	5.52				
	6	75	3.34						
	7	75	0.08						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

310601
41 12 45.0 101 40 50.0
LAKE MCCONAUGHY
31101 NEBRASKA

11EPALES 2111202
4 0117 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT K JEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/06/16	11	15 0000	6.4		36	509	8.40	202	0.040	0.600	0.540	0.007
	11	15 0005	6.4	10.8		510	8.40	199	0.020	0.380	0.550	0.004
	11	15 0015	6.3	10.8		505	8.45	199	0.020	0.200	0.550	0.004
	11	15 0040	6.2	10.8		508	8.45	202	0.040	0.480	0.590	0.003
	11	15 0075	6.2	11.0		504	8.40	203	0.030	0.200	0.560	0.003
	11	15 0110	5.9	10.8		500	8.40	202	0.030	0.200	0.600	0.003
74/07/01	10	40 0000	20.3	7.6	300	721	8.20					
	10	40 0005	19.1	7.4		706	8.20					
	10	40 0020	18.7	7.2		700	8.20					
	10	40 0037	17.2	6.8		680	8.20					
	10	40 0055	14.0	6.4		634	8.10					
	10	40 0080	13.2	4.2		624	8.00					
	10	40 0102	12.9	3.6		622	8.00					
74/09/27	11	15 0000	17.8	7.6	84	665	7.78	184	0.060	0.700	0.380	0.008
	11	15 0005	17.7	7.8		665	7.77	183	0.040	0.580	0.380	0.005
	11	15 0019	17.8	7.4		666	7.77	183	0.040	0.480	0.380	0.004
	11	15 0050	17.8	7.6		666	7.77	185	0.050	0.580	0.380	0.006
	11	15 0085	17.7	7.2		664	7.78	185	0.060	0.480	0.380	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNNG PERCENT
74/06/16	11	15 0000	0.040	12.3	
	11	15 0005	0.027		
	11	15 0015	0.027		
	11	15 0040	0.031		
	11	15 0075	0.026		
	11	15 0110	0.019		
74/07/01	10	40 0000		0.5	
	10	40 0007			50.0
	10	40 0037			1.0
74/09/27	11	15 0000	0.032	12.4	
	11	15 0003			50.0
	11	15 0005	0.026		
	11	15 0019	0.024		1.0
	11	15 0050	0.025		
	11	15 0085	0.027		

STORET RETRIEVAL DATE 75/12/23

318602
41 15 20.0 101 54 20.0
LAKE MCCONAUGHY
31101 NEBRASKA

11EPALES
4

2111202
0065 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/16	11 50	0000	5.6		72	492	8.40	203	0.040	0.300	0.640	0.004
	11 50	0005	5.6	11.0		492	8.40	216	0.030	0.200	0.630	0.003
	11 50	0015	5.5	11.0		492	8.45	212	0.050	0.200	0.670	0.003
	11 50	0030	5.5	11.0		493	8.40	212	0.040	0.200	0.630	0.003
	11 50	0060	5.4	11.0		491	8.40	204	0.040	0.200	0.630	0.003
74/07/01	11 15	0000	20.6	8.2	196	727	8.50					
	11 15	0005	20.6	7.6		729	8.50					
	11 15	0015	20.6	7.4		726	8.50					
	11 15	0033	20.3	7.6		722	8.40					
	11 15	0045	14.8	6.0		643	8.20					
	11 15	0068	14.0	5.2		636	8.20					
74/09/27	12 10	0000	17.2	7.8	48	658	7.87	187	0.060	0.680	0.310	0.005
	12 10	0005	17.2	7.8		658	7.86	190	0.060	0.580	0.310	0.004
	12 10	0015	17.2	7.6		659	7.85	186	0.050	1.200	0.310	0.004
	12 10	0035	17.2	7.6		659	7.86	187	0.050	0.600	0.310	0.004
	12 10	0055	17.2	7.8		659	7.85	189	0.070	0.400	0.320	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/16	11 50	0000	0.023	12.0	
	11 50	0005	0.021		
	11 50	0015	0.018		
	11 50	0030	0.021		
	11 50	0060	0.019		
74/07/01	11 15	0000		1.7	
	11 15	0004			50.0
74/09/27	12 10	0000	0.039	10.1	
	12 10	0005	0.037		
	12 10	0014			1.0
	12 10	0015	0.037		
	12 10	0035	0.035		
	12 10	0055	0.041		

24

STORET RETRIEVAL DATE 75/12/23

310603
41 17 10.0 101 58 00.0
LAKE MCCONAUGHY
31101 NEBRASKA

11EPALES
4

2111202
0022 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/16	12 20	0000	5.9		40	499	8.50	203	0.050	0.400	0.620	0.005
	12 20	0005	5.9	11.4		495	8.50	202	0.020	0.200	0.590	0.002
	12 20	0015	5.8	7.6		495	8.50	202	0.020	0.200	0.600	0.002
74/07/01	11 45	0000	22.9	6.8	24	750	8.40					
	11 45	0005	22.9	6.8		749	8.50					
	11 45	0015	22.5	6.2		742	8.50					
	11 45	0022	22.4	6.8		739	8.50					
74/09/27	12 45	0000	16.0	7.6	14	665	7.95	232	0.110	0.900	0.600	0.006
	12 45	0007	16.1	7.6		667	7.93	232	0.160	0.880	0.590	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/16	12 20	0000	0.038	13.3	
	12 20	0005	0.030		
	12 20	0015	0.027		
74/07/01	11 45	0000		3.1	
	11 45	0005			1.0
74/09/27	12 45	0000	0.104	12.4	
	12 45	0007	0.102		

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/01/27

3106A1
41 12 42.0 101 40 03.0
NORTH PLATTE RIVER
31047 7.5 OGALLALA
O/C W MCCONAUGHY LAKE
BANK SAMPLE AT KINGSLEY DAM SPILLWAY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	17	10	0.208	0.600	0.185	0.052	0.060
74/09/15	14	47	0.248	0.700	0.100	0.010	0.025
74/10/06	13	30	0.336	0.600	0.190	0.025	0.030
74/11/24	15	05	0.540	0.500	0.024	0.016	0.030
74/12/08	09	30	0.540	0.600	0.020	0.015	0.040
75/01/19	09	50	0.650	0.700	0.088	0.020	0.030
75/02/08	15	30	0.688	1.000	0.092	0.016	0.030
75/03/16	14	45	1.005	1.050	0.133	0.036	0.040
75/04/13	10	00	0.690	0.750	0.170	0.015	0.040
75/05/18	13	30	0.680	0.550	0.050	0.005	0.010

27

STORET RETRIEVAL DATE 76/01/27

3106A2
45 19 05.0 102 08 35.0
NORTH PLATTE RIVER
31 7.5 LEWELLEN
T/C W MCCONAUGHY LAKE
CO RD HWY BRDG 1 MI S OF LEWELLEN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	15 20		1.380	0.300	0.015	0.010	0.015
74/09/15	13 16		1.680	1.500	0.060	0.035	0.250
74/10/06	12 05		2.000	1.000	0.030	0.035	0.200
74/11/24	14 00		1.100L	0.700	0.016	0.040	0.100
74/12/08	07 55		2.400	1.300	0.380	0.045	0.110
75/01/19	08 45		2.240	0.800	0.168	0.056	0.060
75/02/08	14 05		2.695	1.000	0.304	0.068	0.090
75/03/16	13 37		2.400	2.200	0.025	0.133	0.120
75/04/13	07 30		2.200	0.950	0.115	0.080	0.220
75/05/18	12 25		1.250	1.050	0.075	0.015	0.180

L ACTUAL VALUE IS KNOWN TO BE
GREATER THAN VALUE GIVEN

STORET RETRIEVAL DATE 76/01/27

3106#1
41 18 30.0 102 03 52.0
GRAF CANAL
31 7.5 RUTHTON
T/C W MCCONAUGHY LAKE
SEC RD BRDG 4.4 MI SE OF LEWELLEN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	16 00		0.528	0.575	0.020	0.125	0.210
74/09/15	13 55		0.720	0.400	0.015	0.100	0.130
74/10/06	12 45		0.690	1.100	0.050	0.110	0.210
74/11/24	12 30		0.416	1.100	0.064	0.024	0.060
74/12/08	08 25		0.768	1.200	0.050	0.045	0.110
75/03/16	14 05		0.371	1.450	0.015	0.033	0.050
75/04/13	08 10		0.062	0.900	0.100	0.030	0.090

STORET RETRIEVAL DATE 76/01/27

3106C1
41 19 21.0 102 02 23.0
CLEAR CREEK
31 7.5 RUTHTON
T/C W MCCONAUGHY LAKE
NE HWY 92 BRDG 5.9 MI E OF LEWELLEN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	15 40		1.260	0.300	0.030	0.080	0.115
74/09/15	13 40		1.360	0.200	0.020	0.080	0.100
74/10/06	12 25		1.480	0.500	0.047	0.085	0.110
74/11/24	14 15		1.100L	0.500	0.064	0.104	0.160
74/12/08	08 10		1.680	0.700	0.040	0.100	0.130
75/01/19	09 00		1.600	0.800	0.032	0.112	0.120
75/02/08	14 30		1.690	0.500	0.082	0.112	0.140
75/03/16	13 50		1.510	0.775	0.062	0.113	0.140
75/04/13	07 55		1.450	0.450	0.037	0.100	0.120
75/05/18	12 35		1.050	0.550	0.075	0.116	0.140

L ACTUAL VALUE IS KNOWN TO BE
GREATER THAN VALUE GIVEN

STORET RETRIEVAL DATE 76/01/27

3106AA AS3106AA P000376
41 19 30.0 102 08 00.0
LEWELLEN
31047 GARDEN CO NE
T/C.W. MCCONAUGHY LAKE
NORTH PLATTE RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/10/07	15 30		0.240	13.000	0.190	3.300	5.500		
74/12/12	14 50		1.560	2.800	0.050K	2.200	3.000		
75/01/07	15 25		2.000	7.400	0.050K	1.880	2.600		
75/02/07	15 20		0.800	1.000K	0.050K	2.300	2.300		0.090
75/03/09	15 35		0.057	3.400	0.192	2.740	3.100	0.080	
75/04/10	14 15		1.280	3.000	0.260	0.300	1.700	0.090	0.080
75/06/25	15 50		0.025	7.300	0.100	2.400	2.500	0.090	0.100
75/07/21	08 30		0.050	21.000	1.250	0.790	1.500	0.063	0.090
75/08/18	08 20		0.050	6.000	0.025K	0.710	1.500	0.106	0.092
75/09/19	10 00		1.800	4.200	0.025K	2.000	2.800	0.063	0.085

K VALUE KNOWN TO BE
LESS THAN INDICATED

31

STORET RETRIEVAL DATE 76/01/27

3106AB AS3106AB P001067
41 24 00.0 102 20 00.0
OSHKOSH
31 GARDEN CO NE
T/C.W. MCCONAUGHY LAKE
NORTH PLATTE RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/10/08	10 45								
CP(T)-			4.120	7.200	0.050K	2.800	10.000		
74/10/08	17 00								
74/11/14	10 00								
CP(T)-			10.000	2.600	0.190	6.900	7.200		
74/11/14	15 30								
74/12/12	10 00								
CP(T)-			9.600	5.200	0.050K	6.600	7.700		
74/12/12	16 00								
75/01/11	10 00								
CP(T)-			16.000	24.000	0.230	7.100	10.500		
75/01/11	15 00								
75/02/14	10 00								
CP(T)-			13.400	7.000	0.000K	7.200	7.300		
75/02/14	16 00								
75/03/21	10 00								
CP(T)-			1.520	4.400	3.700	7.100	7.100		
75/03/21	15 30								
75/04/09	10 00								
CP(T)-			0.640	19.000	0.240		8.600		
75/04/09	15 30								
75/05/12	10 00								
CP(T)-			0.100	22.000	6.200	5.600	8.400		
75/05/12	16 00								
75/06/10	10 00								
CP(T)-			0.050	18.000	9.100	7.200	7.200		
75/06/10	15 45								
75/07/08	09 45								
CP(T)-			0.050	14.000	2.600	5.300	6.400	0.100	0.105
75/07/08	16 30								
75/08/16	09 30								
CP(T)-			1.100	11.000	0.210	6.000	6.875		
75/08/16	14 30								
75/09/08	10 45								
CP(T)-			0.150	13.000	0.125	6.500	8.200		
75/09/08	16 00								

K VALUE KNOWN TO BE
LESS THAN INDICATED

32

STORET RETRIEVAL DATE 76/01/27

3106AB AS3106AB P001067
41 24 00.0 102 20 00.0
OSHKOSH
31 GARDEN CO NE
T/C.W. MCCONAUGHY LAKE
NORTH PLATTE RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/10/07	10 00								
CP(T)-			0.150	12.500	0.433	7.000	9.000		
75/10/07	16 00								